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(54) Title: VEHICLE PARKING BUILDING AND SYSTEM

(57) Abstract: An article storing and retrieving system particularly useful as a vehicle parking building includes a multi-level supporting structure in which each level has a rotatable horizontal platform defining a plurality of storage spaces arranged in a circular array around a central axis common to all the levels. The system further includes elevators extending vertically adjacent to the supporting structure at different locations on the outer periphery of the circular arrays of storage spaces in the levels to enable each elevator to selectively communicate with a plurality of the storage spaces of each rotatable platform according to the rotary position of the platform with respect to the elevator, thereby horizontally moving an assigned parking space towards the vehicle while the vehicle is moving vertically to the assigned level.

VEHICLE PARKING BUILDING AND SYSTEM

FIELD AND BACKGROUND OF THE INVENTION

The present invention relates to an article storing and retrieving system. The invention is particularly useful for providing automated vehicle parking facilities in a building, and is therefore described below with respect to such an application.

Many proposals are known for automated parking systems which use automatic means to take over the vehicle on arrival, park it automatically, and return it to the waiting driver on demand. The rapid developments in computerization and automation save labor costs and make these systems speedier and more reliable. Automatic parking systems seem to offer obvious advantages over ramped garages, such as saving the driver's time and fuel, the elimination of noxious fumes, and the dangers of accidents, theft and violence. That so few mechanical parking systems have become popular or financially successful is probably due to the high costs of the previously proposed systems, and the slow speed in parking and retrieving the vehicles which is a particular drawback during peak hour operations.

Most of the proposals for circular parking garages have a central lift shaft with one or more rotating elevators or platforms which carry vehicles to radially arranged, fixed parking bays on several levels. The transfer of a vehicle to and from the elevator is performed by the use of a dolly, well known in the art, that is guided under the vehicle, lifts it to raise the vehicle's tires off the floor and then transfers the vehicle to the desired location. The dolly can be of various designs but is usually energized by an umbilical electric or hydraulic cord connected to the elevator, and therefore it is practically a part of the elevator system. The dolly can drive only a limited distance to and from the elevator.

These systems are time consuming, no matter how fast the vertical transport and transfer of the vehicles is effected. An additional problem with most

circular parking garages is that they take up too much floor space per vehicle, and therefore their volumetric efficiency is low.

One example of an automatic circular parking garage is:

US Patent No. 5,469,676 by Alfred Colsman, called "Motor Vehicle Parking System", which includes up to five rotating elevators in a central shaft of the parking system. This type of structure is very volume consuming, as the whole large diameter center of the structure cannot be used for parking, but for vehicle transfer. The elevator systems are very expensive because of the side rotation of the elevators, and therefore the whole parking system is very costly.

Another example is US Patent No. 6,004,091 by H.U. Roth which uses rotatable carousels to transfer vehicles to concentric spaces in a round, special purpose building. A few such carousels are used to move the cars vertically and by rotation of the carousel, also horizontally. Major disadvantages of such a system are that only a few such carousels can be used in a parking structure of many levels and that these carousels are not fully independent. In many cases, one carousel is not able to approach the entrance or other level, because another carousel occupies the space at that time so that the time response of the system is relatively large. Also, the center shaft is dedicated to car transfer and therefore the volumetric efficiency of the system is relatively small.

Other examples of patents in the field of automatic parking, some of them of radial structure, include: US 5,478,182; US 5,674,040; US 4,039,089, CH 684,203 A5; and European 0445,712 A1. All use central vertical transportation, are slow in response, and/or are low in volumetric efficiency.

OBJECTS AND BRIEF SUMMARY OF THE PRESENT INVENTION

An object of the present invention is to provide a building having an approved arrangement of parking facilities. Another object of the invention is to provide a parking system particularly useful in buildings requiring a large number of parking facilities within the building.

According to one aspect of the present invention, there is provided a building having vehicle parking facilities, comprising: a multi-level supporting structure; each level of the supporting structure including a rotatable horizontal platform defining a plurality of parking spaces arranged in a circular array around a central axis common to all the levels, with each parking space extending generally radially (i.e., radially or close to radially) with respect to the central axis; and at least one elevator extending vertically through the building for communicating with each of the levels to convey vehicles to, and to retrieve vehicles from, selected levels of the supporting structure; the elevator extending vertically through the building at a location adjacent to a periphery (i.e., the outer periphery and/or the inner periphery) of the circular arrays of parking spaces in the levels so as to face the radial end of the circular array of parking spaces in each level; each of the platforms being rotatable about the common central axis to enable the elevator to selectively communicate with a plurality of the parking spaces of each rotatable platform according to the rotary position of the platform with respect to the elevator.

By thus providing the elevator at a location on the outer and/or inner periphery of the circular arrays of storage spaces, the system enables a large number of elevators to be provided in order to shorten the response times for storing and retrieving articles particularly when the system is designed to have a large capacity by expanding in the vertical direction rather than in the horizontal direction.

According to another aspect of the present invention, there is provided a multi-level building having vehicle parking facilities, comprising: a horizontal rotatable platform on each of plurality of levels, each platform defining a plurality of parking spaces in the respective level arranged in a circular array around a central axis common to all the levels, with each parking space extending generally radially with respect to the central axis; and a plurality of elevators extending vertically adjacent to, and at different locations on, the outer peripheries of the

rotatable platforms for communicating with the parking spaces on the rotatable platforms of each of the levels to convey vehicles to, and to retrieve vehicles from, selected levels of the supporting structure; each of the platforms being rotatable about the common central axis to enable the elevators to selectively communicate with a plurality of the parking spaces of each rotatable platform according to the rotary position of the platform with respect to the elevator.

According to further features in the described preferred embodiments, each of the elevators includes a dolly for transferring a vehicle from the elevator to a selected parking space when parking a vehicle, and from the selected parking space to the elevator when retrieving the vehicle. In addition, at least one of the rotatable platforms can be of annular configuration and includes a dolly at the center of the platform. Preferably, the latter dolly is carried on a turntable at the center of the platform.

According to another aspect of the present invention, there is provided a vehicle parking system, comprising: a rotatable horizontal platform defining a plurality of parking spaces arranged in a circular array around a central rotary axis; and a dolly at the center of the rotatable horizontal platform and selectively alignable with respect to each of the parking spaces.

According to yet another aspect of the present invention, there is provided a vehicle parking system, comprising: a rotatable horizontal platform defining a plurality of parking spaces arranged in a circular array around a central rotary axis; and a turntable at the center of the rotatable horizontal platform and selectively alignable with respect to each of the parking spaces.

According to still further features in several of the described preferred embodiments, the multi-level supporting structure is constructed as a load-bearing core of the building, and the building is further constructed with rooms around the outer periphery of the multi-level supporting structure.

It will thus be seen that a building having automated vehicle parking facilities including the foregoing features provides a number of important

advantages. Thus, it shortens the time for storing or retrieving a vehicle by enabling the multi-level supporting structure to be serviced by a large number of elevators located on the outer and/or inner periphery of the circular arrays of parking spaces and by rotating an assigned parking space to the rotary position assigned to the vehicle while the vehicle is being moved vertically to the assigned level. In addition, it enables the multi-level supporting structure for the parking spaces to be constructed as the load-bearing core of the building, thereby saving on building costs as well as better exploiting the dark central regions of the building for vehicle parking purposes.

Further features and advantages of the invention will be apparent from the description below.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention is herein described, by way of example only, with reference to the accompanying drawings, wherein:

Fig. 1 is a plan view illustrating one level in one form of parking system constructed in accordance with the present invention;

Fig. 2 is a vertical section illustrating several of the multi-level parking areas in the system of Fig. 1;

Fig. 3 is an enlarged vertical section illustrating a part of one level in the multi-level parking system of Figs. 1 and 2;

Fig. 4 is a view similar to that of Fig. 2 but illustrating another construction of a multi-level supporting structure for vehicle parking;

Fig. 5 is a plan view illustrating an example of the ground level in a residential or office building having multi-level parking system in accordance with the present invention;

Fig. 6 is a plan view illustrating an example of an upper level in the residential or office building of Fig. 5;

Fig. 7 is a plan view illustrating another example of a parking level in a building constructed in accordance with the present invention for parking vehicles;

Fig. 8 is a vertical section view illustrating several parking levels in the building of Fig. 7;

Fig. 9 illustrates an example of a basement level in the parking building of Fig. 8;

Fig. 10 illustrates an example at street level in the parking building of Fig. 8;

Fig. 11 is a plan view illustrating a parking level in a parking building according to another embodiment of the present invention;

Figs. 12 and 13 illustrate the street level and an upper parking level, respectively, in another type of parking building constructed in accordance with the present invention particularly useful for parking buildings to be constructed on narrow lots and having access from one side only;

Figs. 14 and 15, illustrate the street level and an upper parking level, respectively, in a further type of parking building constructed in accordance with the present invention also particularly useful for parking buildings on narrow lots and having access from one side only;

Fig. 16 illustrates an example of a double-decker elevator which can be used particularly where there is an entrance level and a separate exit level, in order to increase the vehicle-handling capacity of the elevator; and

Fig. 17 illustrates an example of another embodiment of several parking levels, wherein inner perimeter elevators are installed and possibly supplemented by at least one elevator positioned on the outer perimeter, and wherein the parked vehicles are positioned close to radial alignment with the center line of the elevators;

DESCRIPTION OF PREFERRED EMBODIMENTS

Figs. 1 – 3 illustrate the vehicle parking part of a building having automated vehicle parking facilities in accordance with the present invention. Thus, as shown particularly in Figs. 1 and 2, the building includes a supporting structure, generally designated 2, of cylindrical configuration divided vertically into a plurality of levels 3 each supporting a circular platform 4 rotatable in the respective level around a central axis CA common to all the levels. Each rotatable platform 4 defines a plurality of parking spaces 5 arranged in a circular array for parking vehicles 6, with each parking space extending radially with respect to the central axis CA.

As shown particularly in Fig. 1, the rotatable platform 4 for each level 3 is of annular, or ring-like, configuration to define a central, non-rotatable region 7 of the respective level centrally of the parking spaces. The rotatable platform 4 may be built of sheet metal sufficiently strengthened, as known in the art, to support the vehicles 6, and may be rotated on the respective level 3 by a plurality of wheels or rollers 8 (Fig. 3). In the example illustrated, there are three concentric circular arrays of rollers 8 for rotatably mounting the platform 4 on its level 3, and another circular array of wheels or rollers 9 engaging the inner side of the platform for maintaining horizontal concentricity of the platform 4 with respect to its respective level 3.

The parking system illustrated in Figs. 1 – 3 further includes a plurality of elevators 10 extending vertically through the building at different locations adjacent to, and at different locations on, the outer periphery of the platforms 4 so as to face the radially outer ends of the parking spaces on the respective platform in each level. Fig. 1 illustrates only two such elevators 10 on the outer periphery, but it will be appreciated that the building could be provided with any desired number, and/or on the inner periphery as shown later, according to the number of levels in the building containing the parking system, and the operation time desired for storing and retrieving vehicles from the respective parking spaces. Since the

elevators 10 are located at different locations on the outer periphery of the circular array of parking spaces, and/or on the inner periphery, there is no practical limit as to the number of elevators that may be provided for this purpose up to one elevator for each parking space.

Each elevator 10 is provided with a dolly, shown schematically at 11, for use in transferring the vehicle to and from the elevator when conveying the vehicle to an assigned parking space, or when retrieving the vehicle from the assigned parking space. The dolly 11 can be of any known design, e.g., one energized by an umbilical electric or hydraulic cord connected to the elevator so as to be effectively a part of the elevator system. Particularly useful for this purpose is a dolly manufactured by Palis Technology of Augsburg, Germany, which is 8 cm in height and includes four pairs of pincer rollers, each pair engaging the opposite sides of a vehicle tire and, by a pincer movement, raising it off the ground.

As shown in Fig. 2, the height of each vertical level 3 in the parking area structure 2 may be less than the vertical height between the normal floors 12 of the building structure to thereby increase the capacity of the parking area. For example, the vertical distance between levels in the parking area structure 2 could be about 1.8 meters for conventional cars, and about 2.1 meters for minivans and Jeeps; whereas the vertical height between floors 13 in the conventional building structure are about 3.0 meters.

Instead of mounting the wheels or rollers 8 on the rotatable platforms 4, they can be mounted on the floor of the respective level 3 so that the platforms merely rotate freely on them. The wheels may be made of metal, plastic, or rubber for quiet operation. The rotation of the platforms may be effected by any suitable means (not shown) such as gear trains used in rotating crane structures, cable transmission, belts, chains or other suitable means well known in the field of rotating machinery or cranes.

The cylindrical supporting structure 2 is preferably of concrete, but can also be made of metal. The parking floors 3 are rigidly connected to the cylindrical

structure 2, preferably being cast with it as one concrete structure. In residential, office, or other multi-purpose buildings, the cylindrical structure 2 can serve as the load-carrying core of the building as well as of the parking system, thereby enabling substantial savings to be effected in the remainder of the building structure allocated to rooms, etc. for office or residential use.

The load-carrying cylindrical structure or core, referred to above, may also take the form of a plurality of spaced columns, such as columns 62 described below with respect to Figs. 7-9, and therefore the term "core" or "cylindrical core" as used in the specification and in the appended claims is intended to include such an array of columns.

Fig. 4 illustrates a parking system having a cylindrical supporting structure, generally designated 22, in which each of the rotary platforms, therein designated 24, is also of annular configuration. In this case, however, the rotatable platforms are supported on annular ledges 23 in the cylindrical supporting structure 22, and in another cylindrical supporting structure 25 within and coaxial to cylindrical supporting structure 22. Both structures 22 and 25 may be made of cast concrete. Each of the rotatable platforms 24 may be rotated on rails or wheels 26 supported on the annular ledges 23 of the supporting structures 22 and 25. The ledges 23 thus determine the height of each level of the parking area defined by the supporting structures 22 and 25. Preferably, this height is also less than the height between levels 27 in the remainder of the building structure in order to increase the parking capacity of the parking system and the number of parking levels with respect to the number of residential or office levels.

The construction and operation of the parking system illustrated in Fig. 4 may be the same as described above with respect to Figs. 1 – 3. Thus, the rotatable platform 24 providing the annular array of parking spaces are rotatably supported by the annular ledges 23 in the two cylindrical supporting structures 22, 25. Here, however, the central region within the inner cylindrical supporting structure 25 may be used for service stairs or counter weights (not shown). The elevators, while also

not shown, would also be located on the outer periphery of the rotatable platforms 24, and would each include a dolly, as described above with respect to Figs. 1 – 3.

In residential high-rise buildings in city centers, parking spaces are scarce and very expensive. Figs. 5 and 6 illustrate an apartment building constructed around a multi-level vehicle parking system in accordance with the present invention. The vertical section of such a building may be the same as illustrated in Fig. 4.

Fig. 5 is a plan of the street level of the building wherein it will be seen that it includes a cylindrical structural core, generally designated 32, e.g., of concrete. Cylindrical core 32 is divided into a plurality of levels (as in Fig. 4), each level including a rotatable platform 34 of annular configuration to define a circular array of spaces 35 extending radially with respect to the central axis CA and of a size to accommodate a vehicle 36. In this case, however, the upper levels of the building structure, as will be described below with respect to Fig. 6, include residential and office facilities, in addition to vehicle parking facilities; and therefore the street level of the building structure, as illustrated in Fig. 5, also includes facilities for handling the movement of persons, as well as the movement of vehicles.

Thus, the street level of the building, as illustrated in Fig. 5, includes an entrance lobby 37 having several passenger elevators 38 and a stairwell 39 for the people entering or leaving the building. The street level further includes a vehicle drive-in region, generally designated 40, on one side of the entrance lobby 37, and a vehicle drive-out region 41 on the opposite side.

The vehicle drive-in region 40 preferably includes one or more turntables 42 for receiving a vehicle. Fig. 5 illustrates three such turntables 42 in order to accommodate high traffic conditions. For each turntable 42, there is provided an outer gate 43 to be opened before the vehicle can be driven onto the respective turntable, and an inner gate 44 which also must be opened before the vehicle on the turntable can be transferred to the rotatable platform 35.

The street level of the building structure illustrated in Fig. 5 further includes a plurality of vehicle elevators 46 located on the outer periphery of the rotatable platform 34 for receiving vehicles from the rotatable platform to be conveyed to a higher level, and for transferring from the elevators to the rotary platform vehicles conveyed from a higher level. For this purpose, each of the elevators 46 includes a dolly 47 as described above. In addition, a turntable 48 and a dolly 49 may also be provided in the center region 50 of the rotatable platform 34. Each elevator has a counterweight 29.

The drive-out region 41 at the street level of the building may also include one or more turntables 52, an outer gate 53, and an inner gate 54 between the turntable(s) and the rotatable platform 34.

The upper levels of the building structure, as illustrated in Fig. 6, also includes the cylindrical structural core 32 and a rotatable platform 34 for each level defining a circular array of spaces 35, which in this case serve as parking spaces for parking the vehicles 36. Each such upper level further includes an entrance lobby 37 for the respective level, serviced by the passenger elevators 38 and the stairway 39.

The upper levels also include residential or office facilities. The cylindrical central core 32 of the parking facilities is utilized for also supporting the residential and office facilities. Thus, as shown in Fig. 6, the space in the respective floor outwardly of the cylindrical core 32 is divided into a plurality of apartments, offices, or penthouses. Fig. 6 illustrates, for purposes of example, four such apartments 57 each provided with a terrace 58. It will be appreciated that such apartments or offices can be designed as desired to provide ample light and windows, and this part of the building can take a round, rectangular, octagonal, or any other shape.

A pedestrian gate 55 is provided to enable access to the vehicle after it has been transferred from the rotatable table 34 to a turntable 52 or to a point of the drive-out region 41 not having a turntable. A similar pedestrian gate 56 is provided in the drive-in region 40.

It will thus be seen that in this construction, the central cylindrical core 32 serves not only to provide vehicle parking facilities in the various levels of the building structure, but also serves as a load-supporting structure for the building. Preferably, the cylindrical core 32 is reinforced by internal columns 57 in the central region within the rotatable platforms 34.

The building structure illustrated in Figs. 5 and 6 may be used in the following manner:

A driver entering the drive-in region 40 approaches one of the outer gates 43 and takes a ticket from a parking ticket dispenser at that gate, or slides a credit card through a slot at that gate. Either action opens the gate to enable the driver to enter and drive the vehicle onto the turntable 42 at that location. When the car is satisfactorily parked on a turntable, the driver and passengers leave the vehicle, exit via the pedestrian gate 56 into the entrance lobby 37, and use one of the passenger elevators 38 to travel to the appropriate floor.

When the driver and passengers have left the area of the drive-in turntable 42 (which can be sensed by appropriate sensors in that area), the inner gate 44 is opened, the rotatable platform 34 is rotated to position an empty space 35 in alignment with the turntable. The dolly 49 on the turntable 48 in the central region 50 of the rotatable platform is actuated to transfer the vehicle from the turntable onto a space 35 on the rotatable platform. The platform is then rotated to bring the vehicle to one of the vehicle elevators 46, where the elevator dolly 47 is actuated to transfer the vehicle from the table 34 onto the elevator. The elevator then raises the vehicle to the appropriate level, e.g., as shown in Fig. 6, whereupon the dolly 47 on the elevator is again actuated to transfer the vehicle to one of the empty spaces on the rotatable platform 34 at that level. If desired, additional dollies, corresponding to dolly 49 on the central turntable 48, can be provided on the rotatable platform 34 to speed-up the transfers.

When the driver returns to retrieve the vehicle, the driver inserts an encoded ticket, or credit card, in a pay-automate for paying the appropriate amount,

if payment is based on each time a vehicle is parked and retrieved. It will be appreciated, however, that payment may be made in other manners, e.g., on a monthly basis irrespective of the frequency of use, or as part of the rent, etc.

When the driver thus retrieves the vehicle, the computer will initiate the retrieval action by moving one of the vehicle elevators 46 to the appropriate level while rotating the platform 34 at that level to properly align the respective vehicle with the elevator so that, as soon as the elevator arrives at the appropriate level, the dolly on the elevator may transfer the respective vehicle to the elevator for delivering the vehicle to the ground level. As soon as the vehicle has arrived at the ground level, the dolly then transfers the vehicle to the rotary platform 34 on the ground level, which in turn rotates to bring the vehicle opposite to the appropriate turntable 52 in the drive-out region 41 where it is transferred by dolly 49. Another possibility is to have an exit in the other (outer) side of the elevator and a building exit in the respective side of the building, to enable the vehicle to be directly driven from the elevator without using the rotatable platform on the exit floor. The appropriate location in the drive-out region 41 to which the vehicle is to be delivered is indicated to the driver at the time the driver initiates the vehicle retrieving operation. The drive-out regions 41 can also be provided with appropriate sensors to assure that the driver, and all the passengers, are safely within the vehicle before the respective outer gate 53 is opened.

Figs. 7 – 10 illustrate a building structure intended to be used only for parking vehicles and therefore designed to accommodate a large number of vehicles. Fig. 7 illustrates one of the upper levels of the building structure; Fig. 8 is a vertical section through the upper levels; Fig. 9 illustrates the basement level of the building structure serving as the entrance for driving-in vehicles to be parked; and Fig. 10 illustrates the street level serving as the exit for driving-out the vehicles from the building.

Thus, with respect to Fig. 7 illustrating one of the higher parking levels, it will be seen that the building structure also includes a plurality of elevators 60,

each equipped with a dolly 61, located on the outer periphery of a cylindrical structural core supported by columns 62 for supporting a rotatable platform 64. As in the previously described embodiments, each of the rotatable platforms 64 is of annular configuration to define a circular array of parking spaces 65 for vehicles 66 extending radially with respect to the central axis. The inner region within the rotatable platform 64 may also be provided with a turntable 67 and a dolly 69, as described in the earlier embodiments.

In this case, however, the respective level of the building structure also includes an outer annular array of parking spaces 70 for parking additional vehicles 71. The parking spaces 70 in the outer array are fixed and not rotatable since they serve as additional parking spaces for vehicles conveyed to the respective level by the elevators 60.

Thus, the outer ring parking spaces 70 may be used for parking vehicles 71 by actuating a dolly 69 to convey the vehicle to the respective position on the rotatable platform 64, and then actuating dolly 69 on turntable 67, or another dolly on the rotatable platform, to transfer the vehicle to an empty space 70 in the outer circular ring. When most of the parking spaces are occupied, the central dolly 69 may be stationed in an empty space on the rotatable platform 64 so that it can be immediately available when required to transfer a vehicle from a fixed space 70 in the outer circumference of spaces to a parking space on the rotatable platform 64.

If desired, a third concentric ring of parking spaces (not shown) may be provided around the concentric ring of parking spaces 70 to accommodate a larger number of vehicles, particularly for long term parking.

The entrance to the building is in the basement level, shown in Fig. 9 which is accessible via a low gradient ramped driveway 72. The normal driving direction is shown by the solid arrow heads 72a, whereas in peak hours, the drive-in direction may be reversed, as shown by the outline arrow heads 72b, to permit the ramp 72 also to be used as an exit from the building. Fig. 10 illustrates the street level with the exit 73 at the street level.

Figs. 9 and 10 further illustrate the columns 62 which, in the higher levels (e.g. Fig. 7), are encircled by the rotatable platforms 64 for parking the vehicles. In the basement level of Fig. 9 and street level of Fig. 10, however, the columns 62 are encircled by a plurality of turntables 74. Each turntable 74 is located in front of an elevator 60 whose dolly 61 is used for transferring an entering vehicle (Fig. 9) to the elevator 60 and therefrom to the assigned parking space at a higher parking level. Thus, the elevators 60 communicate both with the outer periphery of the rotatable platforms 64 in the upper levels (e.g. Fig. 8) and the turntables 74 in the basement level (Fig. 9).

The street level as shown in Fig. 10, which serves as the exit level, is similarly provided with a turntable 75 in front of each elevator 60.

Thus, an entering vehicle, entering from the street level via ramp 72 to the basement level shown in Fig. 9 may be driven to one of the turntables 74 as shown by arrow 72a, aligned with one of the elevators 60, and transferred to the elevator by dolly 61 for lifting to the appropriate level (Fig. 8) where it is in turn transferred to one of the parking spaces 65 on the rotatable platform 64 at that level, or subsequently to one of the outer ring of parking spaces 70. A vehicle to be retrieved from a parking space is conveyed by the rotatable platform 64 to one of the elevators 60 at the respective level, and then to the street level (Fig. 10) where it is transferred to one of the turntables 75 from where it can be driven out of the exit 73; alternatively, it can be transferred out of the elevator from its opposite side without using a turntable. The foregoing transfers may be effected by the dollies in the elevators, and/or on the rotatable platform, and/or in the central region of the platform.

As shown in Fig. 10, there is an entrance hall at street level and a lobby 79 connected by an elevator 77 and stairways 78. Drivers and passengers walking between the entrance and lobby and turntables in the basement and entrance levels, would be isolated from moving turntables and vehicle traffic by partitions, roll-down doors and pedestrian doors, as in Fig. 5.

As indicated earlier, and as shown by the arrows 72b in Fig. 9, the traffic in the basement level may be reversed, so that the exit ramp 72 may also be used as an exit for driving out the vehicles at peak periods.

The elevator 60 in the building construction illustrated in Figs. 7 – 10 may be built as a double-decker, to accommodate two vehicles at the same time, one on top of the other as described below with respect to Fig. 16. Such an arrangement, which substantially increases the vehicle-handling capacity of each elevator, can only be used when there are two levels for arrival and departure.

Fig. 11 illustrates another possible arrangement for an entrance/exit level, wherein a plurality of turntables are located on the outer periphery of the rotatable platform 84 defining the annular array of parking spaces. The building may include any desired number of elevators, as shown at 85, and the central region 86 preferably includes a turntable 87 supporting a dolly 88 with rechargeable batteries or quickly-replaceable power packs. Transfers between parking positions on rotatable platform 84 and the turntable are made by dolly 88 at the center of a rotatable platform; whereas transfers between rotatable platform 84 and the elevators 85 are made by the elevator dollies 86. In both cases, correct alignments are effected by rotation of rotatable platform 84 and turntable 80.

Figs. 12 and 13 illustrate the street level, and a parking level, respectively, in another building structure particularly suitable where only a narrow rectangular lot is available, and where the access is from one narrow side only. Thus, the street level (Fig. 12) includes two turntables 90 at the two entrance drive-ins, and a cylindrical structure 92 at the center of a rotatable platform 94 at each level. The building structure illustrated in Figs. 12 and 13 includes two elevators 95 at the outer periphery of the rotatable platform 94 in each level. Elevators 95 equipped with dollies 91 would be constructed and operated as described previously for receiving an entering vehicle from the rotary platform 94 at the entrance level (Fig. 12) and for conveying it to a higher parking level (Fig. 13); and vice versa, when retrieving a vehicle. A retrieved vehicle exits from the street level (Fig. 12) via the

exit drive-out 96. Unused spaces in all the levels may be used for receiving additional vehicles, as shown by vehicles 97 in the level of Fig. 12, and 98 in the level of Fig. 13.

Figs. 14 and 15 illustrate the street level and an upper parking level of another building constructed in accordance with the present invention also particularly useful for narrow rectangular lots where access is from one narrow side only. Thus, the street level (Fig. 14) includes an entrance 100 and an exit 101 from the same side of the building, each communicating with a turntable 102, 103, respectively, with each turntable in turn communicating with an elevator 104, 105, each equipped with a dolly 104a, 105a. The higher parking levels, shown in Fig. 15, show that the elevators 104, 105 are in the outer periphery of central cylindrical core 106 and the rotatable platform 107 supported by the core at each level. The center of the rotatable platform 107 is provided with a turntable 108 carrying a dolly 109 to facilitate transferring the vehicles from and to the rotary platform with respect to the fixed parking places 110 in the outer circle.

It will be seen that the two elevators 104, 105 are located in the corners of the respective levels, and the turntables 102, 103 are directly in front of them in the street level (Fig. 14), with one turntable 102 directly communicating with the entrance 100, and the other turntable 103 directly communicating with the exit 101. Both levels may be provided with additional parking spaces for vehicles, as shown by driver-parked vehicles 111 in the street level of Fig. 14, and by automatically parked vehicles 110 in the upper parking levels shown in Fig. 15.

Fig. 16 illustrates a double-decker elevator which may be used to accommodate two vehicles at the same time, one on top of the other, when there are two levels for arrival and departure. The elevator is built as a regular freight elevator having a cabman 120 suspended on steel cables 121 stiffened by a regular NJ'U beam structure 122. Fig. 16 illustrates the heights between the rotatable platform levels 124 as being equal to levels 123 of the building structure. However, as described earlier, the rotatable platform levels used for parking vehicles may be

less height than in the building structure in order to increase the vehicle-parking capacity of the parking facilities, and this height may even be one value, e.g., 1.8 meters for conventional vehicles and another value, e.g., 2.10 meters, for minivans, as compared to a height of 3.0 meters in the remainder of the building structure. Accordingly, the illustrated elevator 120 includes an upper floor 125 carried by two or more vertically-extending columns 126 and which may be raised or lowered, according to known techniques, to align the upper floor with the level of the rotatable platform 124 from which, or to which, a vehicle is to be transferred. The upper floor 125 includes a dolly 127 for transferring the vehicle on that floor, and a corresponding dolly 127 on the lower floor 129 for transferring a vehicle on that floor. Preferably, both floors may include chocks 130 or the like at both ends of the dolly to prevent horizontal movement of the dolly and vehicle until their respective floors have been aligned with the appropriate level of the rotatable platform 124 or building structure 123 to which or from which the vehicle is to be transferred. Such an elevator may be provided with suitable sensors and controls, as known in the art, to assure that if chocks are installed, they cannot be removed, except when the respective elevator floor is properly aligned with the respective rotatable platform or building level, and so no elevator doors will be required.

Fig. 17 illustrates a further embodiment where two elevators 133 are located at the inside ring of the rotatable platforms, and the vehicles 132 are parked at a slight angle to the radial line, so as to be aligned with the center line of the elevators 133. This configuration could further be enhanced by installing one or more additional elevators 131 in the outer ring and so get faster response.

While the invention has been described with respect to several preferred embodiments, it would be appreciated that many variations and other application may be made. For example, the invention could also advantageously be used for storing and retrieving other forms of articles, such as pallets loaded with goods, vehicle bodies, and the like. In addition, the system could be equipped with sensors, inner locks, and computers, as known in the art, to provide increased

security and to optimize the response time. The system could also include battery-charging stations or battery-packed replacement stations, enabling a spent battery of a dolly to be recharged or replaced whenever necessary.

Further, in some cases, it may be desirable to provide apartment or office buildings with a rotatable platform at the level of the respective apartment or office, so as to be personal to the residents of the respective level. In such case, the rotatable platform at such a level could be compartmentized, to include an enclosure for the parking space of an individual tenant in the respective level, thereby enabling a tenant at the level to move directly from the vehicle to the apartment or office, and vice versa. In addition, other types of transferring devices could be used, other than dollies, particularly where the system is used for storing and retrieving other types of articles. The system could also be used in an underground parking system, such as under public gardens, squares, or any combination under buildings, with the entrance and exits fully underground, or combined with street level.

Many other variations, modifications and applications of the invention will be apparent.

WHAT IS CLAIMED IS:

1. A building having vehicle parking facilities, comprising:

a multi-level supporting structure;

at least some of the levels of said supporting structure including a rotatable horizontal platform defining a plurality of parking spaces arranged in a circular array around a central axis common to all said levels, with each parking space extending generally radially with respect to said central axis;

and at least one elevator extending vertically through said building for communicating with each of said levels to convey vehicles to, and to retrieve vehicles from, selected levels of said supporting structure;

said elevator extending vertically through said building at a location adjacent to a periphery of said circular arrays of parking spaces in said levels so as to face the radial end of the circular array of parking spaces in each level;

each of said platforms being rotatable about said common central axis to enable said elevator to selectively communicate with a plurality of said parking spaces of each rotatable platform according to the rotary position of the platform with respect to the elevator.

2. A building according to Claim 1, wherein there are a plurality of said elevators extending vertically through said building at different locations adjacent to said periphery of the circular array of parking spaces in each level.

3. The building according to Claim 1, wherein said elevator includes a dolly for transferring a vehicle from the elevator to a selected parking space when parking a vehicle, and from the selected parking space to the elevator when retrieving the vehicle.

4. The building according to Claim 1, wherein at least one of said rotatable platforms is of annular configuration and includes a dolly at the center of the platform.

5. The building according to Claim 4, wherein said dolly at the center of a platform is carried by a turntable at the center of the platform.

6. The building according to Claim 1, wherein said periphery at which said elevator is located is the outer periphery of said circular array of parking spaces.

7. The building according to Claim 1, wherein at least one of said levels, serving as an entrance or exit level, includes turntables adjacent to said periphery of the circular array of parking spaces in the respective level.

8. The building according to Claim 1, wherein at least some of said levels include additional parking spaces outwardly of the rotatable platform in the respective level.

9. The building according to Claim 1, wherein each of said rotatable platforms is rotatably mounted on a floor of the building.

10. The building according to Claim 1, wherein each of said rotatable platforms is rotatably mounted on an annular ledge in the respective level of the building.

11. The building according to Claim 1, wherein said elevator is a double-decker elevator with an adjustable floor height, such that it can serve two adjoining levels simultaneously.

12. The building according to Claim 1, wherein said multi-level supporting structure is constructed as a load bearing core of the building.

13. The building according to Claim 12, wherein said building is further constructed with rooms around the outer periphery of the multi-level supporting structure serving as the load bearing core of the building.

14. A multi-level building having vehicle parking facilities, comprising:

a horizontal rotatable platform on each of plurality of levels, each platform defining a plurality of parking spaces in the respective level arranged in a circular array around a central axis common to all said levels, with each parking space extending generally radially with respect to said central axis;

and a plurality of elevators extending vertically adjacent to, and at different locations on, a periphery of the rotatable platforms for communicating with the

parking spaces on the rotatable platforms of each of said levels to convey vehicles to, and to retrieve vehicles from, selected levels of said supporting structure;

each of said platforms being rotatable about said common central axis to enable said elevators to selectively communicate with a plurality of said parking spaces of each rotatable platform according to the rotary position of the platform with respect to the elevator.

15. The building according to Claim 14, wherein each of said elevators includes a dolly for transferring a vehicle from the elevator to a selected parking space when parking a vehicle, and from the selected parking space to the elevator when retrieving the vehicle.

16. The building according to Claim 14, wherein at least one of said rotatable platforms is of annular configuration and includes a dolly at the center of the platform.

17. The building according to Claim 16, wherein said dolly at the center of a platform is carried by a turntable at the center of the platform.

18. The building according to Claim 14, wherein said periphery at which said elevator is located is the outer periphery of said circular array of parking spaces.

19. The building according to Claim 14, wherein at least one of said levels, serving as an entrance or exit level, includes turntables adjacent to the outer periphery of the circular array of parking spaces in the respective level.

20. A building according to Claim 14, wherein said plurality of rotatable platforms are supported on a multi-level supporting structure constructed as a load-bearing core of the building, said building further including rooms around and supported by said load-bearing core.

21. A vehicle parking system, comprising:

a rotatable horizontal platform defining a plurality of parking spaces arranged in a circular array around a central rotary axis;

and a dolly at the center of said rotatable horizontal platform and selectively alignable with respect to each of said parking spaces.

22. The system according to Claim 21, wherein said rotatable horizontal platform is of annular configuration and circumscribes a non-rotating surface centrally of said platform, said dolly being supported on said central non-rotating surface.

23. The system according to Claim 22, wherein the system further includes a turntable on said non-rotating surface centrally of said rotatable horizontal platform, said dolly being supported on said turntable.

24. A vehicle parking system, comprising:

a rotatable horizontal platform defining a plurality of parking spaces arranged in a circular array around a central rotary axis;

and a turntable at the center of said rotatable horizontal platform and selectively alignable with respect to each of said parking spaces.

25. The system according to Claim 24, wherein said rotatable horizontal platform is of annular configuration and circumscribes a non-rotating surface centrally of said platform, said turntable being supported on said central non-rotating surface.

26. The system according to Claim 25, further including a dolly supported on said turntable centrally of the rotatable horizontal platform.

27. A vehicle parking system, comprising:

a rotatable horizontal platform defining a plurality of parking spaces arranged in a circular array in a small angle to the radial line, around a central rotary axis;

and elevators located in the center of the rotatable horizontal platform and pointing towards the center line of the parking spaces.

28. The system according to Claim 27, wherein there is at least one outer elevator in addition to said elevators in the center of the rotatable horizontal

platform, said at least one outer elevator being aligned with the radial center line of the parking spaces.

29. The system according to Claim 27, wherein there is a dolly located in at least one said parking spaces.

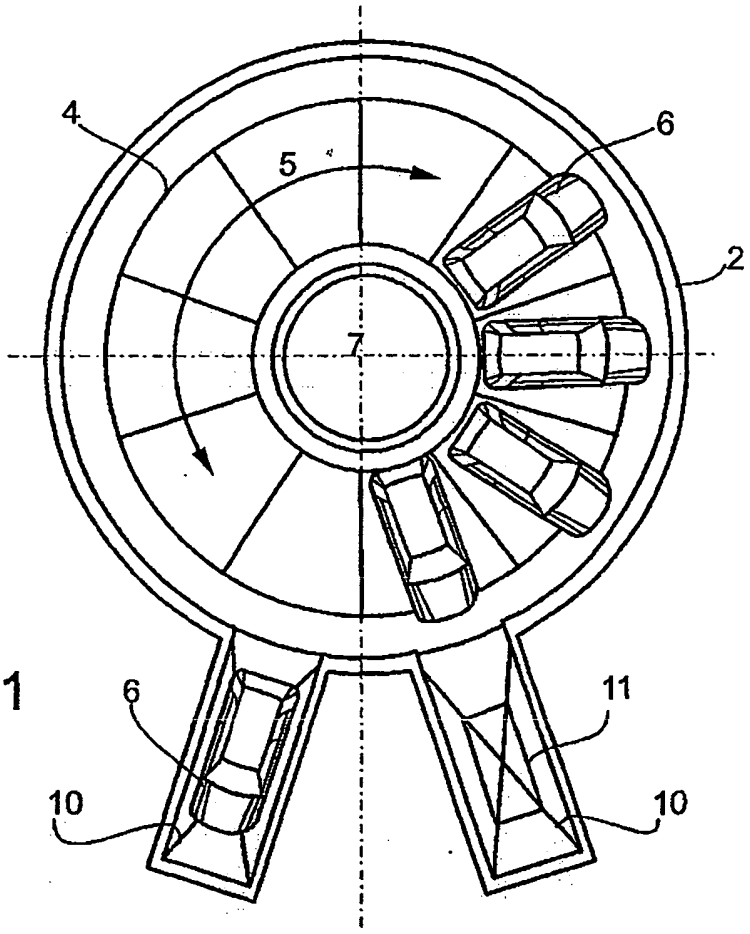

Fig. 1

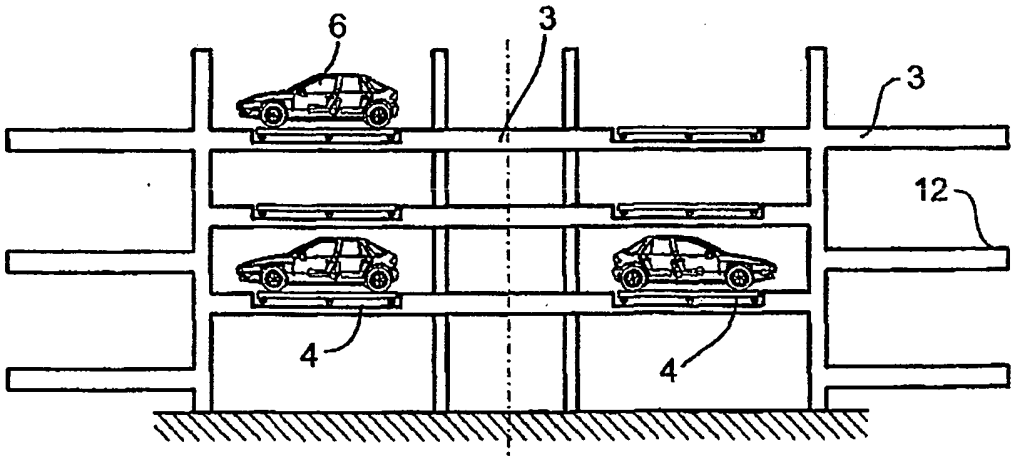

Fig. 2

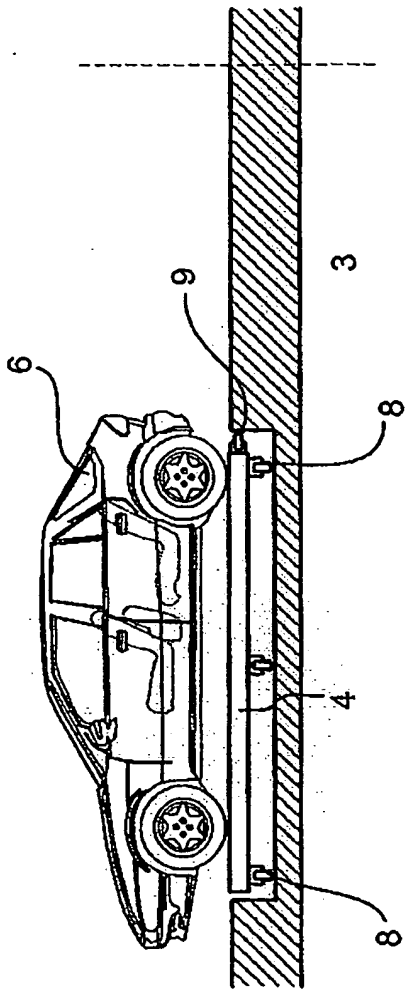

Fig. 3

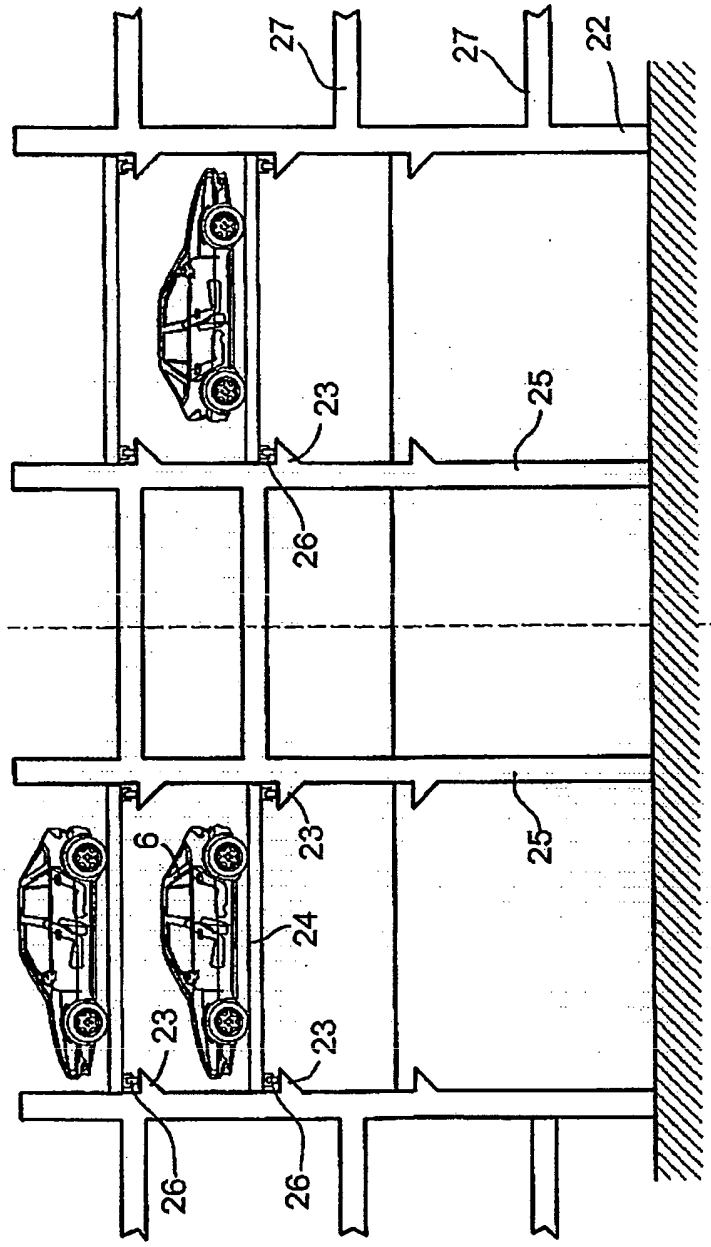

Fig. 4

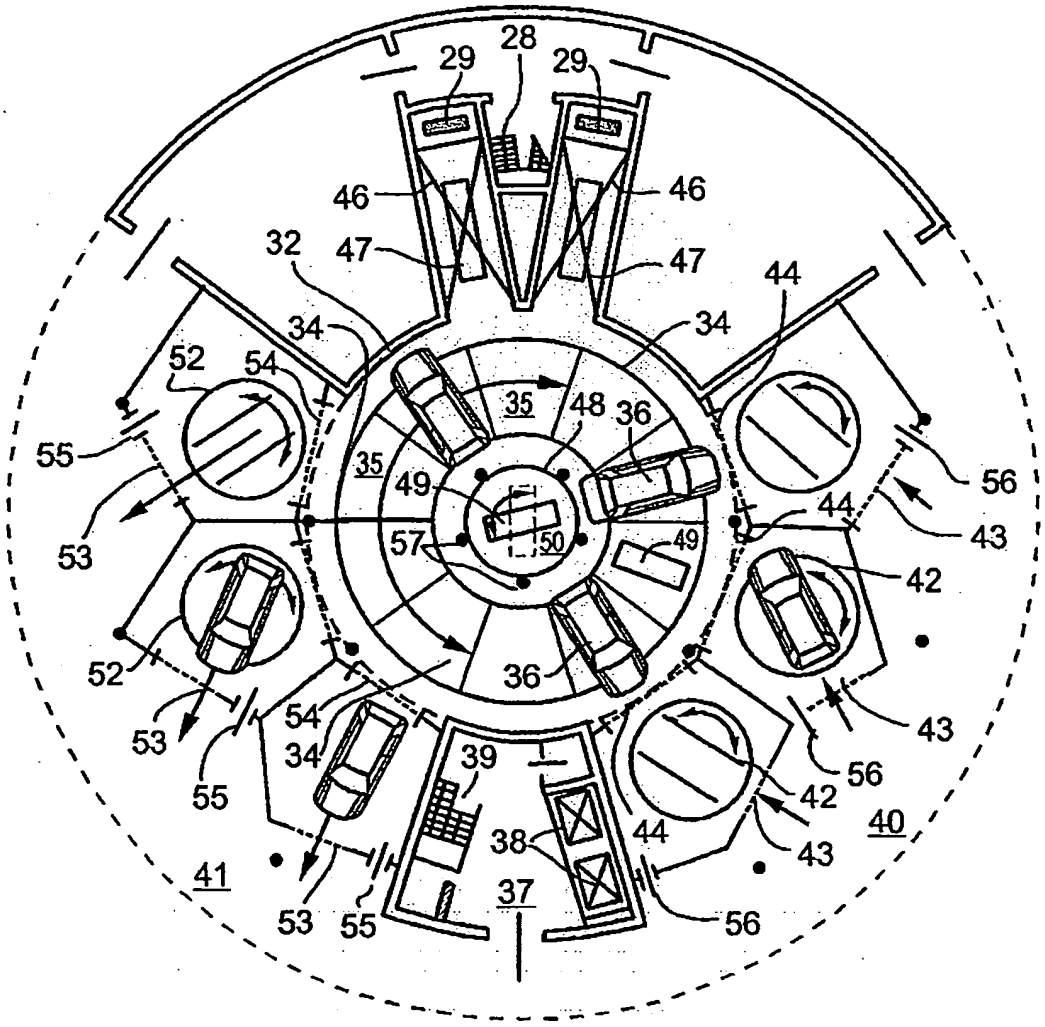
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Fig. 5

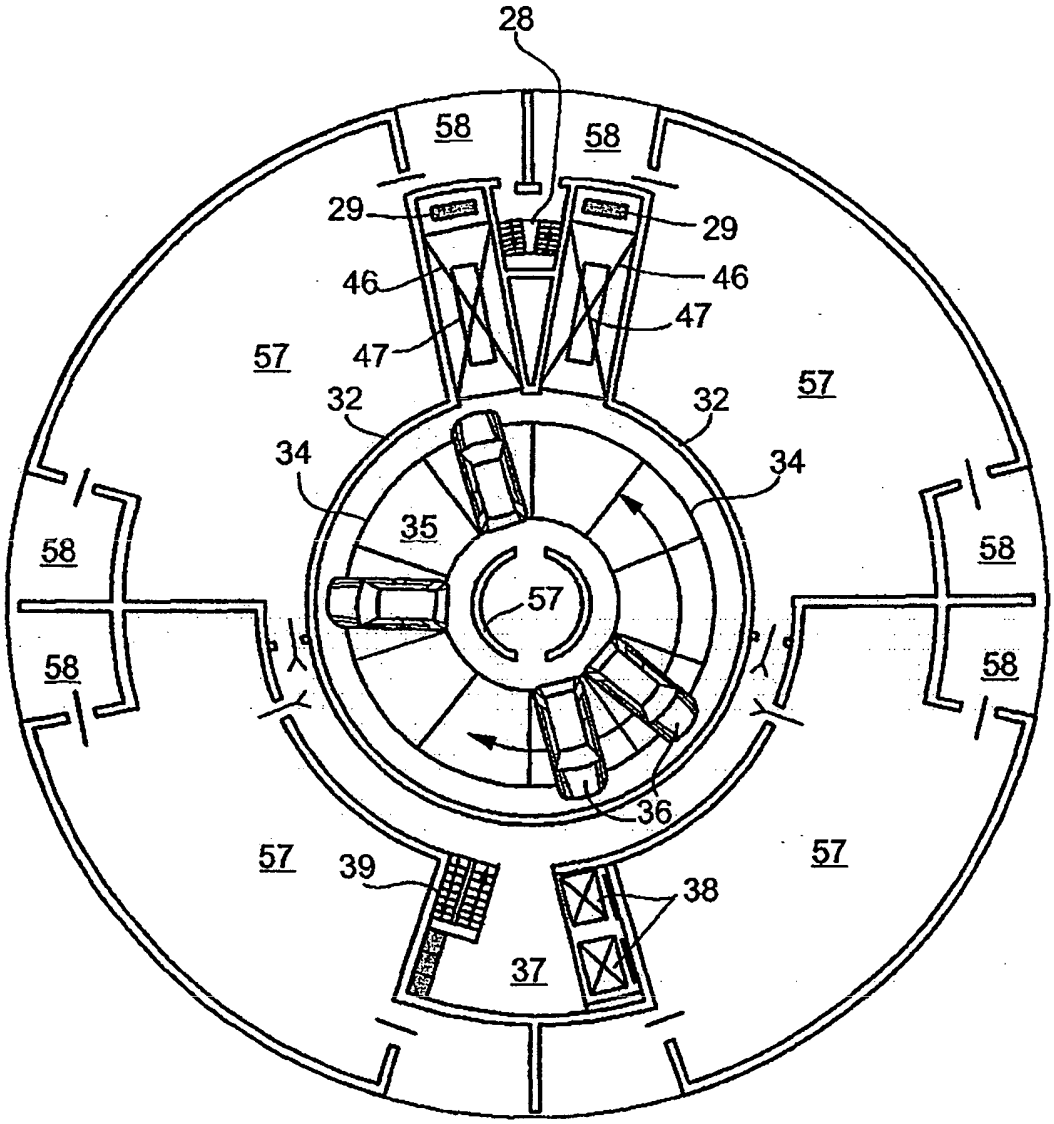
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Fig. 6

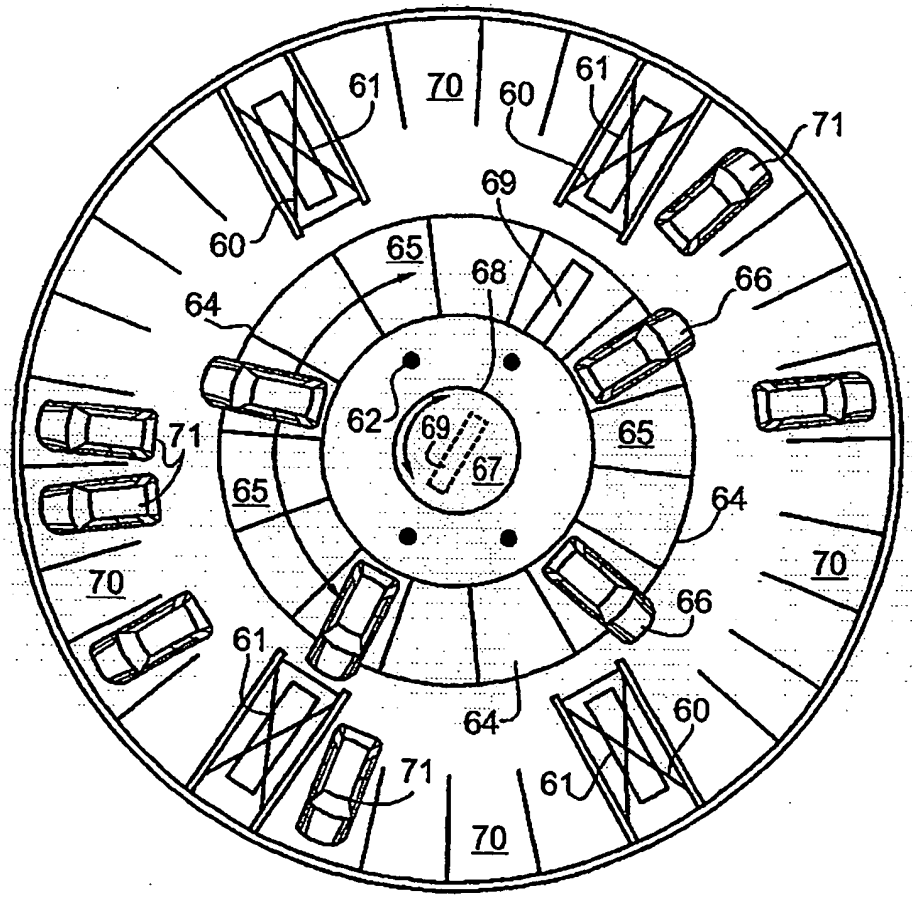
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Fig. 7

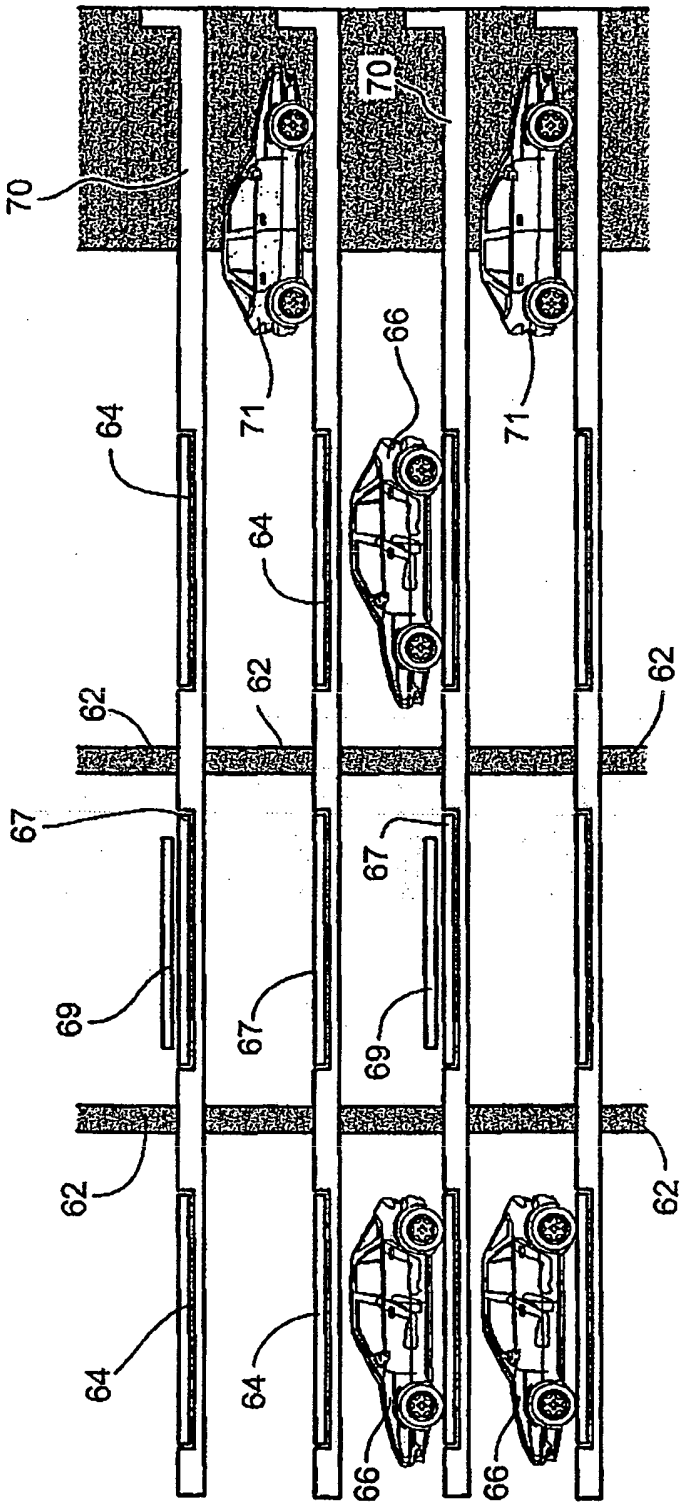

Fig. 8

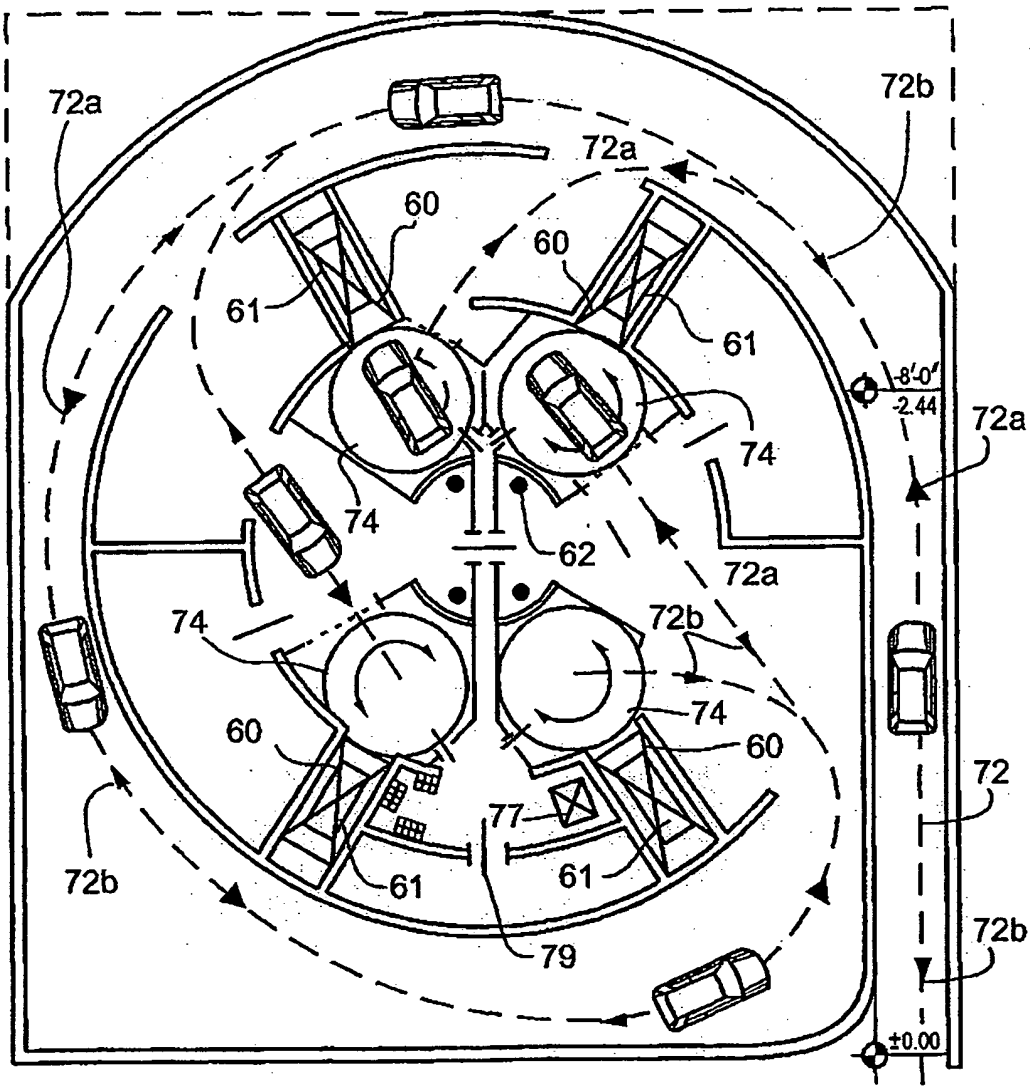
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Fig. 9

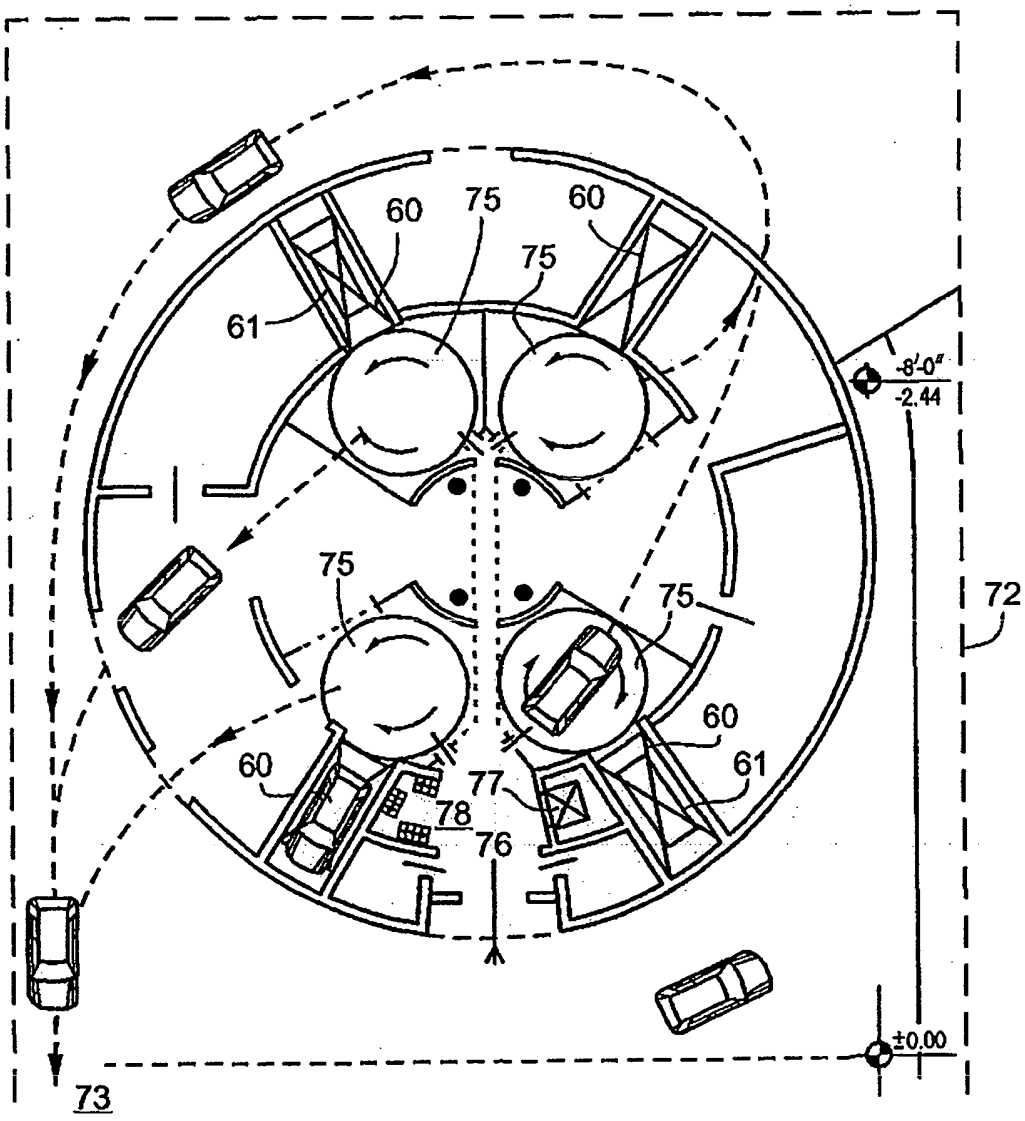

Fig. 10

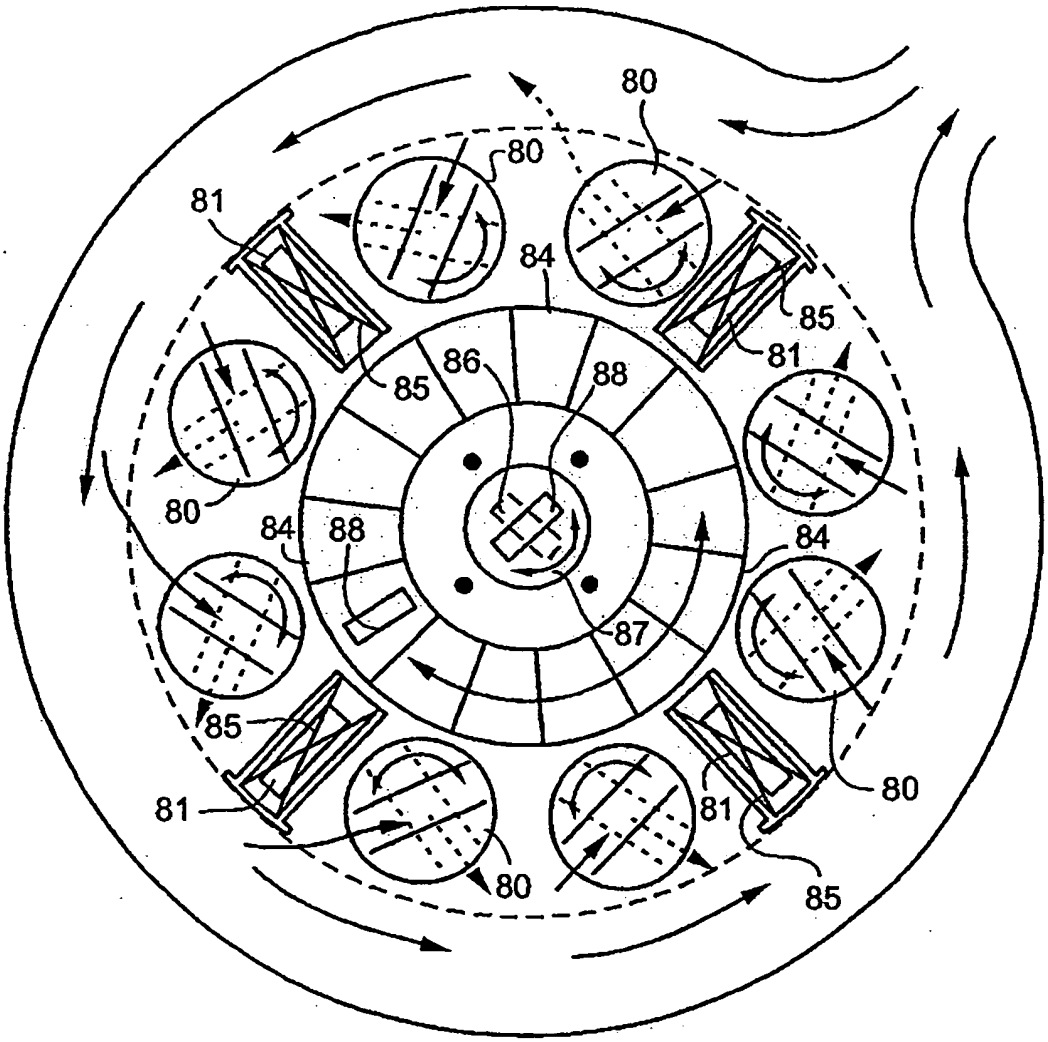

Fig. 11

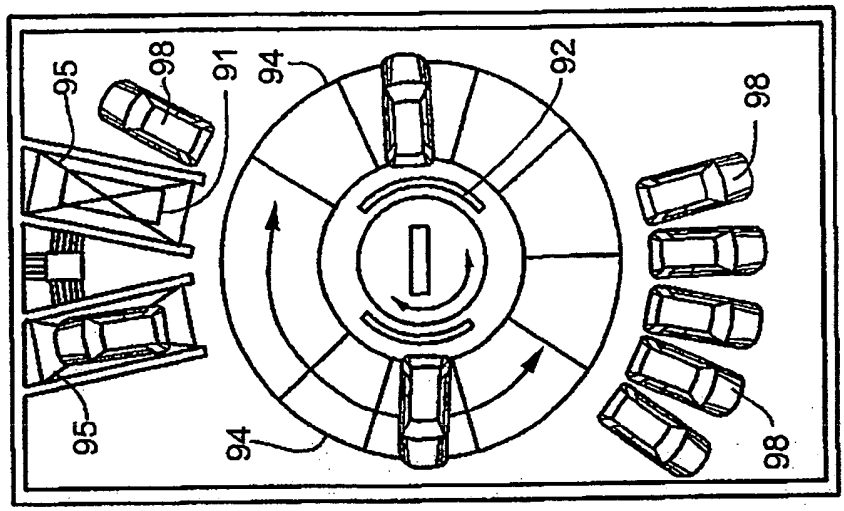

Fig. 13

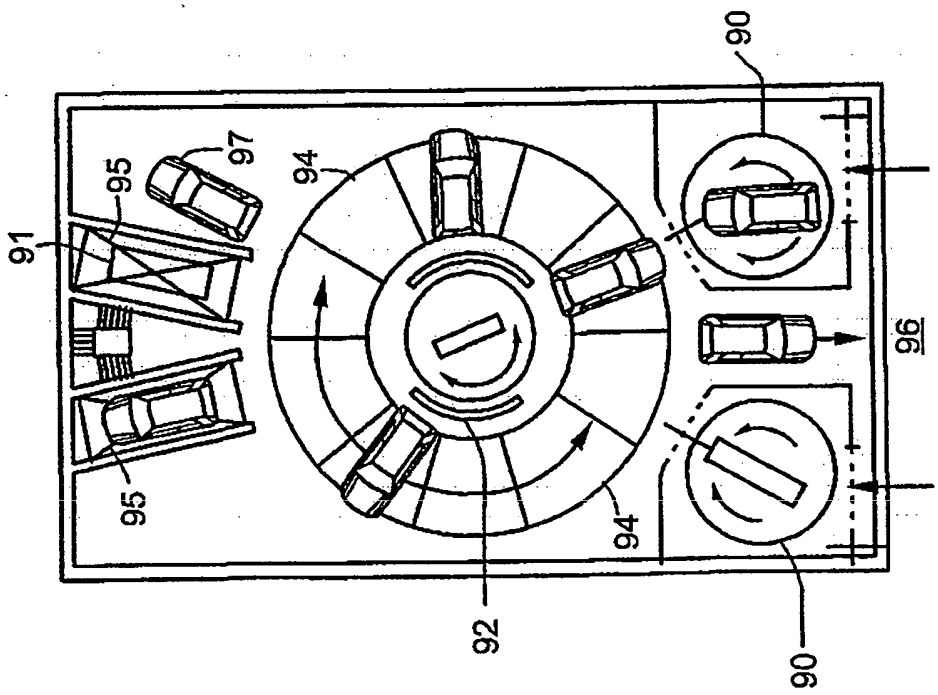

Fig. 12

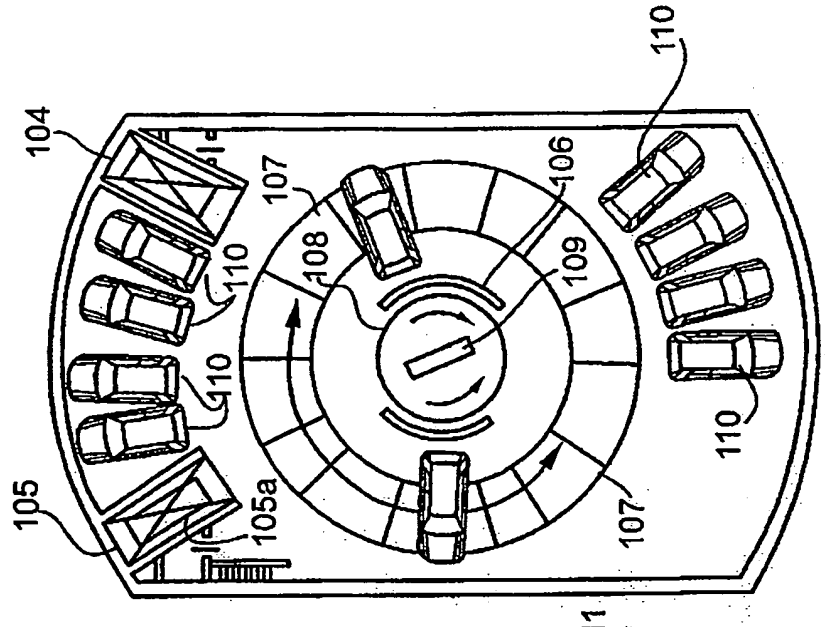
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Fig. 15

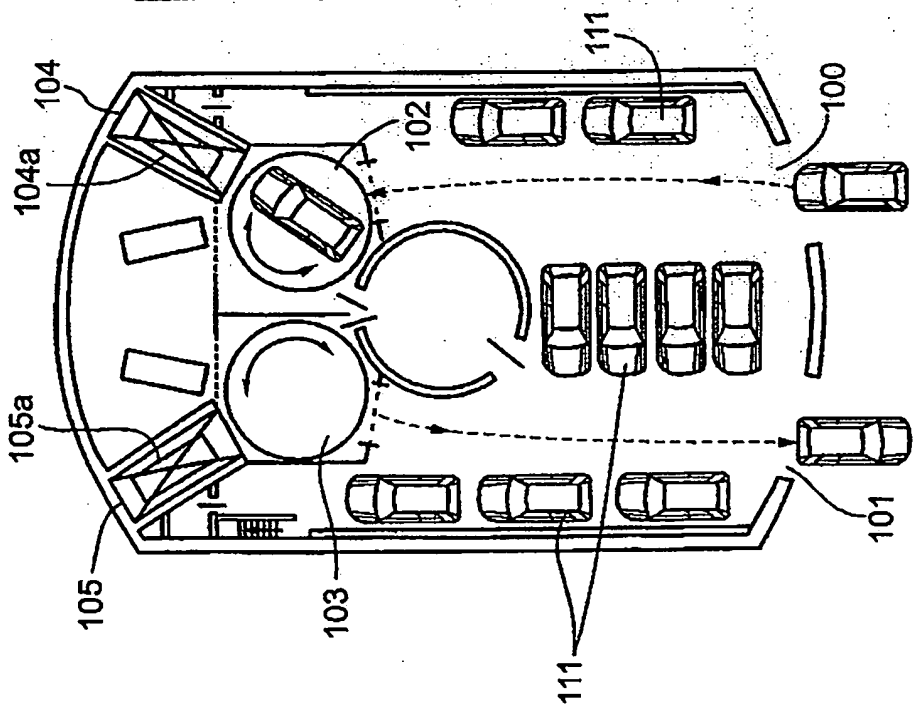
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Fig. 14

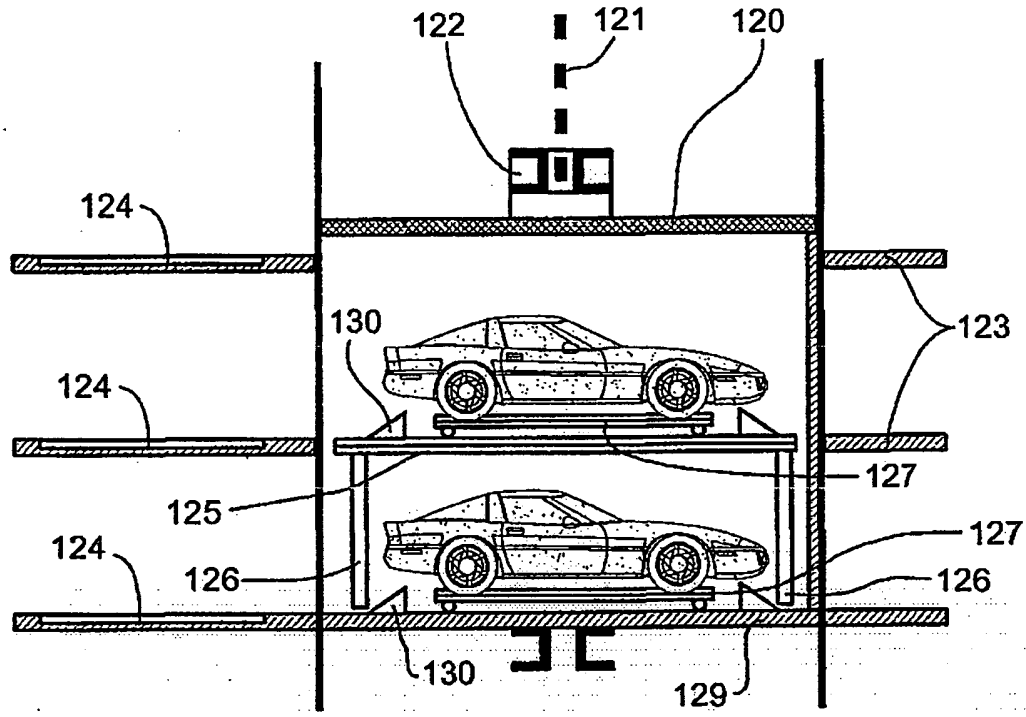

Fig. 16

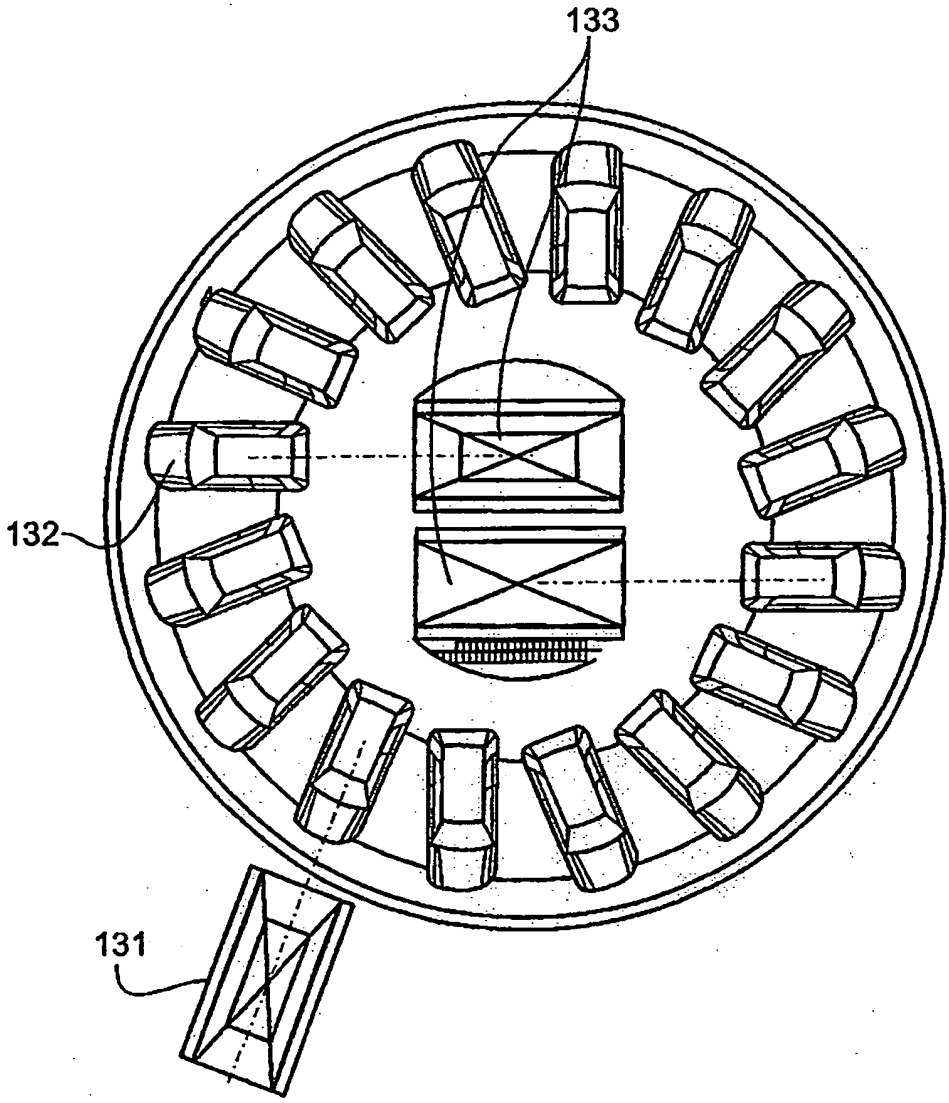

Fig. 17